WHAT HAS CHANGED IN OUR PERSPECTIVE?

A variety of factors has caused us to rethink our perspective of the wireless messaging industry. None of these factors emerged overnight, but our perspective on some of these issues has slowly evolved over the last few months. As all of these issues collectively reached critical mass, our view on the sector changed from being mildly positive to neutral/slightly negative and resulted in our downgrade of the sector on February 7. Some of the important factors include:

- Competition from within the industry may intensify, as indicated by our "top-down/bottom-up" analysis. There simply may not be enough subscribers for all paging operators to meet expectations.
- Competition from digital cellular/BPCS, while not a short-term risk, is a significant longer-term risk that needs to be addressed by wireless messaging companies.
- Pager leasing distorts operating cash flow (EBITDA) to such an extent that it has made us more uncomfortable with present paging valuations, especially relative to cellular.
- High financial leverage and tightening financing options in a capital-consuming industry are not a great recipe for success.
- Whatever potential equity returns are promised today are primarily a result of high leverage, not the promise of strong business fundamentals.
- Trading multiples, especially relative to cellular, are not very attractive.

What Has Changed Recently to Merit the Downgrade?

Not much, except for our perception of the facts and issues. Just as different people can come to different conclusions after evaluating the same information, our view of the same facts and issues has evolved. We are coming to a different conclusion after viewing pretty much the same facts, except that we have developed a somewhat greater appreciation for a variety of issues including the longer-term threat from digital cellular/BPCS, the potential competition within the industry, the continued diminishing quality of paging companies' balance sheets, and the likely tightening of capital markets for paging companies. With all these issues outstanding, we came to the conclusion that wireless messaging companies are not likely to outperform the market over the short term. Investors have other places to put their money and are unlikely to wait for these companies to resolve these issues.

Isn't This Downgrade a Little Late?

Better late than never. Despite the significant declines in equity prices, it is not easy to make a case that these companies are significantly undervalued considering our revised view of the industry. While equity values have declined significantly, total enterprise values (total net debt and equity) have declined much less. For example, the equity price of Arch Communications is down 75% from about a year ago, while its enterprise value is down only about 25%. With such high leverage, debt accounts for a significant portion of total enterprise value, which may still provide for significant upside or downside. Because of some of the factors delineated above, we see the upside scenario as unlikely and risky until some industry issues are addressed. If some of these industry issues are addressed or change, then we would be willing to reconsider our position.

MAJOR ISSUES TO WATCH

We would keep an eye on several issues over the next 12-18 months that can affect the paging industry:

- Continued perception that broadband PCS is going to "kill" paging
- Progress of narrowband PCS rollouts
- Pricing in the reseller channel
- Subscriber net adds in the paging industry
- Capital availability

Until the above issues can be addressed to alleviate investor concerns, confidence in the wireless messaging industry will remain low. We believe that some of the issues can be addressed but that some of them will be difficult for wireless messaging operators to solve.

See page 29 for our discussion of the threat of broadband PCS

Broadband PCS Cloud Over the Wireless Messaging Industry

Whether or not the threat of digital cellular/BPCS is actually real, the **perception** is that the risk is real. Until that perception changes, paging stock valuations are unlikely to increase significantly without any catalysts to change the minds of investors. The onus will be on paging companies to prove that digital cellular/BPCS is not a risk, which can only be proven with positive performance over time.

Broadband PCS has been introduced in many major cities, including Washington, D.C., New York, and Dallas, and while it is too early to tell what the actual impact of BPCS has been on paging carriers, we do not believe that it has affected subscriber growth (so far). PageNet even stated recently that in markets where PCS services have been offered for several months (including Virginia and Salt Lake City), PageNet's growth was 32%, vs. 27% in all of its other markets. Even though PageNet reported higher growth in markets where BPCS has been operational during 1996, other factors may account for at least some of the difference in growth rates.

Over the shorter term, we do not believe that broadband PCS will have much, if any, of an impact on paging. In fact, digital cellular/BPCS may even stimulate usage of paging over the shorter term. Paging has shorter-term advantages relative to analog cellular such as longer battery life, higher reliability, and better in-building penetration.

Longer term, however, there is a case to be made that broadband technologies can capture part of the wireless messaging market. Market segmentation will likely maintain some barriers between digital cellular/BPCS and wireless messaging, but the real question is how much of an inroad digital cellular/BPCS may make.

Narrowband PCS Rollouts

Rollout of NPCS has been slower than expected, largely because of the complication of NPCS networks. These are fundamentally very different from traditional paging networks because they have return channels. With traditional paging, operators can get up and running by putting a transmitter on top of a tall building and cranking up the power to cover a 30-mile radius. Two-way NPCS networks require much more finesse and have some resemblances to cellular networks. NPCS operators need to find many sites in a city for transmitters and receivers, similar to cellular. Because frequencies must be reused, NPCS operators must be careful with power levels, just as with cellular. Many sites must be used for the network to be

able to "hear" a transmission coming from the subscriber unit because the unit broadcasts at such a low power level.

The following table contains a comparison of some of the major operators' NPCS rollout plans.

Table 2: Comparison of Narrowband PCS Strategies

	CONXUS Communications	MobileMedia	Mtel	PageMart	PageNet
Licenses (Nationwide, or Close to)	- 50 kHz/50 kHz - 125 kHz/125 kHz (SMR)	- 50 kHz/12.5 kHz - 50 kHz/12.5 kHz	- 50 kHz/50 kHz - 50 kHz/12.5 kHz - 50 kHz	- 50 kHz/50 kHz - 50 kHz	- 50 kHz/50 kHz - 50 kHz/50 kHz - 50 kHz - 125 kHz/125 kHz (SMR) - 125 kHz/125 kHz (SMR)
Technology	InFLEXion	ReFLEX 25	ReFLEX 50	ReFLEX 25/InFLEXion	InFLEXion/ReFLEX 25
Services	Voice messaging	Data	Data	Data/Voice messaging	Voice messaging/Data
Rollout Date	Six months after PageNet	Unknown	September 19, 1995; "relaunch" 4/97	Early 1998	2/24/97 in Dallas/Fort Worth
Rollout Schedule	All markets within 18 months	Unknown	Still working on improving markets	Undecided	All major markets by end of 1997

Source: Company reports and JPMS forecasts.

CONXUS: Doing "VoiceaLittleLaterThanPageNet"
CONXUS Communications will be launching voice messaging services six months after VoiceNow (PageNet has a six-month exclusivity agreement with Motorola and Glenayre for InFLEXion technology). CONXUS has signed memoranda of understanding with 17 of the top 20 U.S. paging companies to resell its services, including exclusive agreements with Arch, Metrocall, and MobileComm, and has numerous resale arrangements with agents and resellers.

MobileMedia: On Hold
MobileMedia has two nationwide NPCS licenses but does not have sufficient capital to pursue NPCS at this time; the company may actually sell one or both of its licenses for capital.

Mtel: SkyTel 2-Way
Mtel launched its two-way service in September 1995 but has experienced problems with coverage and utility of subscriber devices. The company is planning to relaunch its two-way services in April 1997 with improved coverage, reliability, service offerings and a wider variety of subscriber devices.

PageMart: Delayed Until 1998
PageMart is currently beta testing ReFLEX 25 in both Dallas and Austin but recently announced that it will delay its commercial rollout until early 1998. In its decision to hold off on the rollout, management mentioned that it would like to wait for the next generation of subscriber devices.

PageNet: VoiceNow
PageNet has experienced delays in its rollout of VoiceNow, the first voice messaging service over a two-way network, but finally launched the system commercially in the Dallas/Ft. Worth area on February 24. The company has committed to providing nationwide coverage by the end of 1997.

COMPETITION FROM DIGITAL CELLULAR/BROADBAND PCS

We hold two opinions on the risk of competition from digital cellular/BPCS: one concerning the short term and the other concerning the long term. Our view of the short term has not changed much, if at all; digital cellular/BPCS is not much of a threat. However, our view of the long term has changed; digital cellular/BPCS is only in the infancy stage and, once fully rolled out, will change the dynamics between wireless messaging and wireless voice telephony. Because of this potential shift in the competitive landscape, there are significant implications for the valuations of wireless messaging companies.

Short-Term Threat of Competition From Digital Cellular/Broadband PCS

As we already mentioned, we do not see this as a major threat, and we suspect that most investors would agree that this is not an issue over the next three to five years. The following table presents some of the characteristics of wireless messaging and compares them relative to digital cellular/BPCS over the short term.

Table 18: Comparison of Services Over the Short Term (Three to Five Years)

Type of Characteristic	Characteristic of Wireless Messaging	Characteristics of BPCS/Digital Cellular	Advantage for Wireless Messaging Over Short Term
Direction of Communications	*Inbound*	*Outbound*	x
Primary Use	Data	Voice	x
Type of Communication	Non-Realtime	Realtime	x
Coverage (Breadth)	Broad	Limited	x
Coverage (Depth)	Robust	Spotty	x
Nationwide Coverage	Seamless	Patchwork	x
Technology	Single	Multiple	x
Transmission Power	High	Low	x
Broadcast Method	Simulcast	Narrowcast	x
Battery Life	3 Months	3 Days	x
Network Architecture	Broadcast	Narrowcast	x
Cost of Service	About $10	About $50	x
Bill Predictability	High	Low	x
Size of Unit	Very small	Small	x

Digital cellular/BPCS may be stimulative over the short term

The conclusion for the investor is that over the next few years, we see wireless messaging and wireless voice telephony as being two distinctly different markets that likely will not step on one another's toes too much. **In fact, we would even support the contention that digital cellular/BPCS is potentially stimulative for wireless messaging as awareness of wireless is increased,** but only over the shorter term.

Long-Term Threat of Competition From Digital Cellular/Broadband PCS

Digital is the enabling technology

The threat over the longer term is where our thinking has changed. Our thinking has evolved to incorporate our view of what we believe wireless services will be like five to 10 years from now. We believe it is important to think of the positioning of wireless messaging relative to wireless voice telephony, not statically as the relationship is today, but in terms of how the two services will be five to 10 years from now. When looked at in this light, we come to the conclusion that some of the future growth of wireless messaging companies is at risk considering the evolution of wireless voice telephony technologies. We believe it is imperative for wireless messaging companies to redefine their industry positions relative to the wireless voice telephony industry to defend their subscribers. Essentially, we have lost some of our confidence in our longer-term subscriber projections for wireless messaging companies and are not likely to regain our faith until wireless messaging operators articulate how they plan to contend with the changing landscape of the wireless industry over the next few years.

What Are Some of the Changing Dynamics in the Wireless Industry?

The wireless voice telephony industry is in the midst of significant change that will cause it to look considerably different by the end of the decade. To illustrate how we see some of these changes evolving, we have provided a table which summarizes the different characteristics of wireless messaging relative to digital cellular/BPCS over the longer term. Notice that the advantages of wireless messaging in the table below diminish from the short-term scenario which was presented in the previous section.

Table 19: Comparison of Services Over the Long Term (Five to 10 Years)

Type of Characteristic	Characteristic of Wireless Messaging	Characteristics of BPCS/Digital Cellular	Advantage for Wireless Messaging Over Long Term
Direction of Communications	Inbound	Outbound/Inbound	
Primary Use	Data	Voice/Data	
Type of Communication	Non-Realtime	Realtime/Non-Realtime	
Coverage (Breadth)	Broad	Broad	
Coverage (Depth)	Robust	Improved	x
Nationwide Coverage	Seamless	Patchwork/More integrated	x
Technology	Single	Multiple/Dual-mode handsets	x
Transmission Power	High	Low	
Broadcast Method	Simulcast	Narrowcast	
Battery Life	3 Months	7 Days	Reduced
Network Architecture	Broadcast	Narrowcast	x
Cost of Service	About $10	About $50/lower per minute	
Bill Predictability	High	Higher	
Size of Unit	Very small	Very Small	

Direction of Communication

Prior to narrowband PCS (NPCS), the direction of communication for wireless messaging was solely inbound to the subscriber device. Even after the rollout of NPCS, wireless messaging communication will remain primarily inbound. When cellular arrived 13 years ago, many thought that analog cellular would render paging useless because it could offer inbound capabilities to the subscriber device. Well, that prediction did not come true, for a variety of reasons. Some of the main reasons were attributable to advantages of pagers over cellular, which were highlighted in Table 18. Essentially, paging was able to fill a void on which cellular could not deliver reliably.

Digital is the agent of change. We believe that the implementation of digital technology will increase the inbound capabilities of digital cellular/BPCS phones. With digital cellular/BPCS. subscribers are becoming able to receive numeric messaging, alphanumeric messaging and voice mail notification. With improved inbound capabilities in digital cellular/BPCS phones, the argument that wireless voice telephony subscribers cannot be reached reliably loses some of its strength.

As for wireless voice telephony today, the direction of communication is about 20% inbound/80% outbound. Initial reports from BPCS operators indicate that traffic is changing and approaching more of a 50/50 balance. We believe that over the longer term, wireless voice telephony networks will become much more reliable, that traffic over these networks will become much more balanced, and that subscribers will freely disseminate phone numbers to others and leave their phones on. That begs the question, "Why do I need a pager to tell me that someone wants to contact me when I can just leave my phone on and have the person contact me in one shot?" Does this mean that paging dies completely? Of course not, but it does plant a seed of doubt in our subscriber projections.

Primary Use of Service

Today, the primary use of wireless messaging is data while the primary use of wireless voice telephony is voice. Today, just under 90% of paging subscribers use numeric pagers that display up to 10 numeric characters. Most of the balance of subscribers use alphanumeric services.

By the end of the decade, wireless messaging will still be primarily data-centric, with the exception of wireless voice messaging services such as VoiceNow from PageNet. Wireless voice telephony, however, while still primarily offering voice services, will be able to offer all of the data services, and more, that wireless messaging services can.

Now, let's pick apart why some paging subscribers use the services that they use. About 90% of paging subscribers use numeric pagers, which display only 10 numeric characters. Why? The obvious answer is that the paging subscriber wants others to be able to let him/her know that he/she should contact the sender of the message. What will the need for this type of service be when 40-50% of the U.S. population (a commonly accepted figure) have digital phones with considerably longer battery lives and the ability to receive pages? We believe many people will simply answer calls instead of having to respond to a page to call someone. Does this mean that numeric paging service dies? No, but it puts numeric paging as a standalone service at risk.

What is a paging company to do if this is the case? We see alphanumeric paging as an area that paging operators need to develop aggressively to provide value to subscribers.

Type of Communication

Today, all wireless messaging is non-realtime, while the majority of wireless voice telephony is realtime. One of the selling points of paging is that it is non-realtime and that the subscriber has the discretion to return the message at his/her convenience. Investors on the buy-side are familiar with the concept of non-realtime communication: We on the sell-side often communicate with you through voicemail (or even reports). The investor on the buy-side gets to control when/if to return the call. By the way, call with questions on this report.

Non-realtime and realtime communications appeal to different people. Over the longer term, wireless messaging will have more realtime capabilities while wireless voice telephony will develop and promote more non-realtime capabilities. Market segmentation will allow both wireless messaging companies and wireless voice telephony companies to successfully capture different niches.

Coverage (Breadth)
Both wireless messaging and wireless voice telephony have relatively similar coverage areas, as measured by breadth. With both services, there are some areas with extremely low population densities in which service in unavailable. While cellular breadth of coverage is adequate, it is still in the midst of expanding. As for BPCS, it is only beginning to be rolled out, and it will be quite a while until breadth of coverage approaches that of cellular.

Longer term, breadth of coverage may actually be an advantage for digital cellular/BPCS. Here is the reasoning: with dual-band/dual-mode handsets, digital cellular/BPCS subscribers will be able to roam onto multiple networks, which in the aggregate are likely to have better coverage than any one wireless messaging company. Wireless messaging devices, on the other hand, are tuned to access only one network. There is no concept of roaming. So it will not necessarily matter if BPCS builds out all areas, because the same handset can roam to a cellular network that may cover unserved BPCS areas.

Coverage (Depth)
This measure refers to how good network coverage is in a general area with respect to penetrating buildings, minimizing deadspots, and delivering messages. In general, traditional paging networks provide better in-building penetration, largely because they broadcast messages at a higher power level than cellular/BPCS.

As digital cellular/BPCS develop, depth of coverage is anticipated to improve significantly. Cellular networks are already utilizing microcells that better cover buildings where deadspots existed. The entire concept of PCS is to build more microcells to offer better coverage and improve the reliability of accessing the network.

Traditional paging is not failsafe for message delivery, either. In fact, digital cellular/BPCS have a feedback loop in the message delivery protocol which guarantees message delivery and will deliver messages to the subscriber unit upon reentering the network coverage area. No traditional paging operator can guarantee message delivery because traditional paging networks do not possess feedback loops. NPCS networks do possess feedback loops that will enable wireless messaging companies to provide guaranteed message delivery.

Nationwide Coverage
There is one element to breadth of coverage in which wireless messaging should have a long-term advantage, on average. Most of the large wireless messaging operators have the ability to provide service nationwide on one network. This compares with wireless voice telephony operators who collectively cover the nation, but as single operators only cover particular regions. The exceptions to this would be Sprint PCS and Nextel, which can provide nationwide coverage with one network at one frequency. To the extent that having messages delivered by one carrier on one network is important to subscribers, wireless messaging may be in a better position to deliver.

Technology

This is a good news/bad news story for paging relative to wireless voice telephony. The good news is that all wireless messaging operators in the U.S. use the same (typically Motorola) standards – FLEX, POCSAG, ReFLEX 25, ReFLEX 50, and InFLEXion. As a result, equipment is cheaper because equipment manufacturers can achieve economies of scale.

Wireless voice telephony operators, on the other hand, use a variety of technologies: analog, CDMA, TDMA or GSM. Although wireless voice telephony operators use a variety of technologies, each of the technologies will likely reach critical mass to such a degree that some significant economies of scale are realized. The scale economies just won't be as high as if there were only one technology.

The bad news part of the story for paging operators is that because the technology is uniform for all paging operators, the product is essentially a commodity. This makes it difficult for paging operators to differentiate the service and makes it easier for subscribers to churn to another operator. For digital cellular/BPCS, different technologies are often used by different operators, a factor that may minimize the opportunity for subscribers to churn from one network to another while using the same subscriber device.

Transmission Power

As we mentioned earlier, paging transmits at a higher power than cellular/BPCS. This means that paging signals can travel farther and have a better chance of penetrating buildings where most of us work and live.

Over the longer term, as wireless messaging companies develop two-way networks, those two way networks will begin to resemble cellular networks more and more. Either more transmitters will be constructed and power levels will decrease in transmitters or more receivers will be constructed to receive very low power transmissions from subscriber devices. This is a necessity for the network to become truly two-way and receive messages from subscriber devices.

Broadcast Method

Paging operators simulcast transmissions while cellular networks narrowcast transmissions. With simulcast transmission, the same message is broadcast from multiple transmitters simultaneously. This increases the probability of the message arriving at the subscriber unit because the message is coming from a variety of directions. With narrowcast transmission, one transmitter is used to broadcast a message to a subscriber. On a cellular network, the switch decides which transmitter can best communicate with a subscriber and hands off a subscriber to another cell site if the signal is stronger at another cell site.

Another reason that traditional paging networks use simulcast transmission from multiple transmitters is because the network does not know the location of the subscriber; traditional paging networks do not have a return channel from the subscriber unit to communicate. Narrowband PCS networks will have a return channel, and as a result do not need to simulcast messages but may do so to increase the robustness of the network in delivering messages on the first try. Cellular networks, in contrast to traditional paging networks, have send and return channels. As a result, the cellular network can track a subscriber and deliver a message through the nearest cell site.

Battery Life

There is a great difference between the battery life of paging and cellular today. Battery life for pagers is measured in weeks or months, while for analog cellular phones it is measured in minutes, hours, or days.

But where does battery life evolve from here, and how much "juice" is enough? There are three basic ways to increase battery life in a cellular phone. The first is to improve the energy-storing composites of the battery. The three generations of batteries in use today, in ascending order of battery life, are nickel cadmium, nickel metal hydride, and lithium ion. Not only will these composites improve, but new composites are being developed with better capabilities. The second way to increase battery life is to consume a given amount of energy more efficiently. Digital technologies used by cellular and BPCS are providing about triple the talk and standby times of phones simply because they conserve power better than analog phones. The third method is to simply use larger batteries. This last alternative depends on the desires and needs of the subscriber, but in general, this is the least desirable method of increasing the battery life of a phone.

How much "juice" is enough? We believe that a combination of a week of standby and four hours of talk time is sufficient so that the issue of battery life becomes much less important. Why a week? It fits into a natural cycle of human behavior in which subscribers can consistently put the phone in the recharger cradle, say every Sunday morning. A cycle every two or three days may not be easy enough for most subscribers to follow. Once digital cellular/BPCS subscribers can recharge on a weekly cycle, it probably wouldn't even matter if pager battery life is extended to one hundred years. We believe one week of battery life for rechargeable batteries is enough for most people.

Digital phones are coming out with 8.5 days and even three weeks of standby

Most analog phones today provide 90-120 minutes of talk time or 16 hours of standby, which is not enough by our standard; but battery life is not static. Some digital phones today offer up to 10.5 hours of talk time or 8.5 days of standby. Notice that we highlighted the "or" when we specified battery lives. By our measure, it must be an "and." Even more impressive, at the most recent CTIA convention Philips unveiled a new GSM phone that offers 10 hours of talk time and **three weeks of standby time**. That's right, you correctly read three weeks of standby. This phone is currently available in Europe and should be available in the U.S. by the end of the year. This is a vast improvement over today's widely used analog phones, but these much greater battery lives will be the standard within the next few years with digital technologies and better batteries.

Network Architecture

Paging networks are fundamentally broadcast networks while cellular/BPCS networks are narrowcast networks. With traditional paging, all pagers on a network are tuned into a specific frequency and are programmed to "listen" for specific capcodes that identify messages relevant to that specific pager. With cellular/BPCS, all cellular phones on a network are tuned into a control channel to "listen" until the network notifies the phone to tune into a particular channel to make a connection.

Because of the broadcast architecture of traditional paging networks, it is easy to broadcast the same messages to all subscribers on a network, such as news stories. As long as all pagers have these general capcodes programmed into memory, then all pagers can leverage off of a single transmission. In theory, cellular/BPCS networks could do the same, but they must also use their control channels to communicate with the subscriber devices.

Cost of Service

On average, paging costs about $10 per month while cellular/BPCS costs about $50 per month. This differential creates market segmentation for those who simply do not believe cellular/BPCS provides enough value to merit a $50 per-month cost.

But where is pricing going to be within five to 10 years? Most paging operators would argue that pricing will decline very modestly (excluding the effect of lower pricing to resellers, which is an issue of mix and not pricing). Pricing for cellular/BPCS, however, is likely to fall from $0.40-0.50 per minute to $0.05-0.20 per minute within the next five to 10 years. In fact, Palmer Wireless, a cellular operator in Georgia and Alabama, has recently instituted a price plan at $0.10 per minute, replacing one that was about $0.30 per minute. Substantially lower per-minute pricing for cellular/BPCS service with only modestly lower paging pricing will lessen the attractiveness of paging relative to cellular/BPCS.

Cellular/BPCS operators also have the ability to improve their competitive position by giving subscribers a bigger bang for the buck by providing more minutes of use for a given monthly fee. As long as the capacity exists on the network, there is little if any incremental cost to provide the extra minutes. Even if there is not enough capacity on the existing network, the operator can spend more capital to install more radios at cell sites to increase capacity where needed. In essence, this is what Palmer Wireless did in the example above. But what can paging operators do? If they already provide flat-rate pricing, the only way to give subscribers a bigger bang for the buck is to lower the monthly fee. If excess capacity exists on the network, the other alternative is to load on more subscribers at a price at least as high as the marginal cost of adding the subscriber to the network. This sounds familiar to what happened to some paging operators in 1996 when paging operators added subscribers to use excess capacity at extraordinarily low pricing because marginal pricing was all that was needed to cover the costs.

Bill Predictability

Paging is typically charged as a flat monthly fee while cellular/BPCS is charged according to usage. As a result, paging bills are more predictable than cellular/BPCS bills. More and more these days, cellular/BPCS operators talk about providing large amounts of minutes at low incremental rates, which will likely increase the predictability of cellular/BPCS bills in the future.

Size of Unit

Pagers are smaller and lighter than most cellular phones today. But what will be the common size of cellular/BPCS phones within five to 10 years? In fact, a Motorola StarTAC phone is not much larger than a Motorola Advisor Gold pager and may even be lighter. The point is that some cellular phones are already in the ballpark today size-wise compared with pagers. Those cellular phones that are on the cutting edge today will be the average phone within a few years – just look at the progress of cellular phones over the last 13 years.